A Systematic Review of Business Incubation Research

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ABSTRACT. This article systematically reviews the literature on business incubators and business incubation. Focusing on the primary research orientations—i.e. studies centering on incubator development, incubator configurations, incubatee development, incubator-incubation impacts, and theorizing about incubators-incubation—problems with extant research are analyzed and opportunities for future research are identified. From our review, it is clear that research has just begun to scratch the surface of the incubator-incubation phenomenon. While much attention has been devoted to the description of incubator facilities, less attention has been focused on the incubatees, the innovations they seek to diffuse, and the incubation outcomes that have been achieved. As interest in the incubator-incubation concept continues to grow, new research efforts should focus not only on these under-researched units of analysis, but also on the incubation process itself.

JEL Classification: M13, O2, O31, O32, O38

1. Introduction

Incubator-incubation research began in earnest in 1984 with the promulgation of the results of *Business Incubator Profiles: A National Survey* (Temali and Campbell, 1984). Underscoring the enthusiasm of early researchers, only three years passed before two literature reviews were generated (i.e., Campbell and Allen, 1987; Kuratko and LaFollette, 1987). However, since these early efforts to synthesize and analyze the state of incubator-incubation science, and despite the fact that the body of research has grown considerably in the intervening years, a systematic review of the literature remains conspicuously absent.

The primary objectives of this article are to systematically review the incubator-incubation literature and to provide direction for fruitful future research. Ultimately 38 studies were included in our review. We included a study in our review if it viewed the incubator as an enterprise that facilitates the early-stage development of firms by providing office space, shared-services and business assistance. When examining the literature chronologically, five primary research orientations are evident: incubator development studies, incubator configuration studies, incubatee development studies, incubator-incubation impact studies, and studies that theorize about incubators-incubation. While these orientations are not necessarily orthogonal, we employ them as classifications of convenience that we hope will facilitate a discussion of the literature.

We have limited the review in several ways. First, we confine our coverage of the literature to studies devoted explicitly to incubators and/or incubation. Although the locus of the incubator-incubation concept is the nexus of forces involving new venture formation and development, new product conceptualization and development, and business assistance (each of which has an established body of research), to expand the scope of the review beyond research explicitly focused on incubators-incubation would make this research project impossible to complete on a timely basis. Second, although practitioner literature has influenced academic research, we center our review on the academic literature, except in cases where the practitioner literature has proven especially influential and has some intrinsic academic face validity. Third, with our long-term research interests in mind, we selected literature that conceptualizes incubators-incubation as a strategy

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for facilitating new business development rather than as a strategy for developing real estate.

While this review is primarily intended for researchers who are considering potential research topics, we also believe that it will be of use to incubation industry stakeholders who are interested in understanding the epistemological evolution of the incubator-incubation concept. Our contribution is a synthesis and analysis of concepts, empirical findings, and problems related to extant incubator-incubation research, as well as an identification of potential areas for future research.

In this section, we have noted the need for a systematic review of the literature, provided a working definition of the incubator-incubation concept, and delimited the scope of our review. The remainder of the article is organized in the following manner. First, we describe the methodology we employed in identifying and selecting articles for review. Second, we provide a formal definition of the incubator-incubation concept, place incubator-incubation literature in its historical context and review the research along the five primary research orientations described above. Third, we identify several challenges within extant research and suggest new avenues for future research. Specifically, we note the need for future research to address the lack of convergence in the terms and concepts of discourse related to incubators-incubation, the lack of theoretically meaningful incubator classifications, the lack of a business incubation process model, and the long-standing challenges in the definition and measurement of incubator-incubatee "success". We conclude by emphasizing the need to identify and unpack the variables of business incubation with a view toward developing theories that help to explain how and why the incubation process leads to specific incubation outcomes.

2. Methodology for identifying articles for review

To identify the population of publications for review, we conducted an electronic journal database search of ProQuest-ABI/Inform, Science Direct and UMI Dissertation Abstracts using the search terms "incubator" and "incubation". Our objective was to conduct a census of all published research on incubators-incubation written in English between 1984 and early 2002. After identifying and retrieving all articles archived electronically in the databases identified above, we read the bibliographies of these articles to identify other articles on incubators-incubation published prior to electronic archiving or not archived in the electronic databases, and subsequently retrieved those articles. We reviewed those articles' bibliographies and found yet more articles dealing with various aspects of incubators-incubation and repeated the process of retrieving articles and reading through the bibliographies. Reasonably confident that all extant articles on incubators-incubation had been identified and retrieved, we then checked all of the retrieved articles against a bibliography created by the National Business Incubation Association (NBIA) in 2001 that lists all (peer-reviewed, non-peer reviewed and popular press) articles related to incubation in order to ensure to the best of our ability that the entire population of articles on incubators-incubation had been collected. The articles considered for review appear in the following journals: *American Journal of Small Business, Economic Development Quarterly, Economic Development Review, Entrepreneurship Theory and Practice, Harvard Business Review, IEEE Transactions on Engineering Management, Journal of Business Research, Journal of Business Venturing, Journal of Developmental Entrepreneurship, Journal of Product Innovation Management, Journal of Property Management, Journal of Small Business Management, Policy Studies Journal, Public Administration Quarterly, Regional Studies, Research Policy, Technology Management,* and *Technovation*.[1]

Ultimately 35 articles (26 empirical studies and nine non-empirical studies), two dissertations and one national survey were included in this literature review (a complete listing of the studies reviewed is included in Appendix A). The distribution of articles among journals was highly skewed toward journals with an economic development perspective: Six articles appeared in *Economic Development Quarterly* and another four articles appeared in *Economic Development Review*. Considering the high number of often-cited publications appearing in these two periodicals, it is clear that the economic development perspective has influenced the field of published business incubation studies.

The complete distribution of research perspectives applied to business incubation studies is detailed in Appendix B.

3. Primary research orientations

In this section, we offer a formal definition of the incubator-incubation concept. Next we briefly describe the historical context in the United States in which incubator-incubation research has evolved. Then we review the literature, using the five primary research orientations mentioned above as our organizing principle. When reporting key findings of each research orientation, we stratify the results based on their relevance to three different units of analysis: community, incubator, or incubatee.

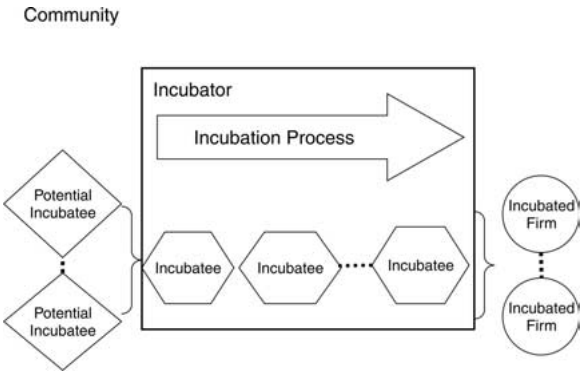

Figure 1. Incubator-incubation concept map.

What is the incubator-incubation concept?

Based on insights gleaned from reviewing the literature as well as from conducting fieldwork in Asia and North America, we offer the following definition: A business incubator is a shared office-space facility that seeks to provide its incubatees (i.e. ''portfolio-'' or ''client-'' or ''tenant-companies'') with a strategic, value-adding intervention system (i.e. business incubation) of monitoring and business assistance. This system controls and links resources with the objective of facilitating the successful new venture development of the incubatees while simultaneously containing the cost of their potential failure.[2] Additionally, we offer the following corollary: When discussing the incubator, it is important to keep in mind the totality of the incubator. Specifically, much as a firm is not just an office building, infrastructure and articles of incorporation, the incubator is not simply a shared-space office facility, infrastructure and mission statement. Rather, the incubator is also a network of individuals and organizations including the incubator manager and staff, incubator advisory board, incubatee companies and employees, local universities and university community members, industry contacts, and professional services providers such as lawyers, accountants, consultants, marketing specialists, venture capitalists, angel investors, and volunteers. Figure 1 graphically depicts the incubator-incubation concept defined here.

Historical context of incubator-incubation development in the USA

It is generally accepted that the first incubator was established as the Batavia Industrial Center in 1959 at Batavia, New York (Lewis, 2002). A local real estate developer acquired an 850,000 ft^2 building left vacant after a large corporation exited the area (Adkins, 2001). Unable to find a tenant capable of leasing the entire facility, the developer opted to sublet subdivided partitions of the building to a variety of tenants, some of whom requested business advice and/or assistance with raising capital (Adkins, 2001). Thus was the first business incubator born.

In the 1960s and 1970s incubation programs diffused slowly, and typically as government-sponsored responses to the need for urban/Mid-western economic revitalization. Notably, in the 1960s interest in incubators-incubation was piqued by the development of University City Science Center (UCSC), a collaborative effort at rationalizing the process of commercializing basic research outputs (Adkins, 2001).[3] In the 1970s interest in the incubator-incubation concept was further catalyzed through the operation of the National Science Foundation's Innovation Centers Program, an effort to stimulate and institutionalize best practices in the processes of evaluating and

commercializing selected technological inventions (Bowman-Upton *et al*., 1989; Scheirer, 1985).

In the 1980s and 1990s the rate of incubator diffusion increased significantly when (a) the passage of the Bayh-Dole Act in the U.S. Congress in 1980 decreased the uncertainty associated with commercializing the fruits of federally funded basic research, (b) the U.S. legal system increasingly recognized the importance of innovation and intellectual property rights protection, and (c) profit opportunities derived from the commercialization of biomedical research expanded. In this environment several incubator development guides[4] as well as non-academic reports and articles[5] with a geographic and normative focus on current or potential business incubation efforts were generated. This surge in report-generating activity in the early 1980s and the formation of the *NBIA* in 1985 underscore the growth in popular interest in business incubation in the 1980s. Concurrent to these and other local efforts at studying and unleashing the potential of business incubation to foster economic development, academic incubation studies began in earnest. Much of this early research addresses the questions ''What is an Incubator?'' and ''What do we need in order to develop an effective incubator?'' *Business Incubator Profiles: A National Survey* (Temali and Campbell, 1984), a ground-breaking survey of 55 business incubators, is the first academic attempt to address these questions by describing in detail the incubators operating in the United States. It is comprehensive in scope, taking the incubator, the incubator manager, the incubatees, and the services provided by the incubator as various units of analysis. Although this survey does not test hypotheses or attempt to build theory, its rich descriptive data and insightful perspective established a platform upon which much subsequent incubator development research is based.

In the late 1990s, fueled by irrationally exuberant stock valuations of several for-profit incubators and/or their incubatees, the media popularized a fantasy of business incubators as innovation hatcheries capable of incubating and taking public ''infinitely scaleable, dot-com e-business start-ups'' less than a year after entering the incubator. This fantasy and the incubator-incubation concept were largely abandoned and left for dead by the popular press after the collapse of the United States' stock market bubble.[6] However, rumors of the demise of the incubator-incubation concept are ''greatly exaggerated''. The media reached its negative conclusions regarding incubators-incubation while fixated on for-profit incubators, a relatively small segment of the total incubator population.[7] The vast majority of incubators are non-profit entities that continue to incubate below the ''radar screens'' of most journalists.

Since the establishment of the first business incubator, most incubators have been established as publicly funded vehicles for job creation, urban economic revitalization, and the commercialization of university innovations, or as privately funded organizations for the incubation of high-potential new ventures (Campbell and Allen, 1987). The fact that most incubators are publicly funded is not trivial. Despite normative incubation industry association positions asserting the importance of operating incubators as enterprises that should become self-sufficient, profit-oriented intentionality has not been translated into profitability for the majority of publicly funded incubators (Bearse, 1998). Financial dependency forces incubators to operate in a politically charged environment where they must constantly demonstrate the ''success'' of the incubator and its incubatees in order to justify continued subsidization of incubator operations with public funds. Such a politically charged environment can tempt incubator-incubation industry stakeholders to underreport incubator-incubation failures and over-report successes.[8] For the researcher interested in understanding, explaining and building models of incubator-incubation phenomena, the politically charged environment and the state of subsidy-dependency in which many non-profit incubators operate cannot be ignored.

Overview of research orientations

We review the literature along the following five primary research orientations: incubator development studies, incubator configuration studies, incubatee development studies, incubator-incubation impact studies, and studies theorizing about incubators-incubation. These orientations, their

Table I
Overview of incubator-incubation literature

Research streams / Characteristics	Incubator development studies	Incubator configuration studies	Incubatee development studies	Incubator-incubation impact studies	Studies theorizing about incubators-incubation
Research period	1984–1987	1987–1990	1987–1988	1990–1999	1996–2000
Main topics	• Definitions • Taxonomies • Policy prescriptions	• Conceptual frameworks • Incubatee selection	• New venture development • Impact of planning on development	• Levels and units of analysis • Outcomes and measures of success	• Explicit and implicit use of formal theories (transaction cost economics, network theory, entrepreneurship, economic development through entrepreneurship)
Research question(s)	• What is an incubator? • How do we develop an incubator? • What life cycle model can be extracted from analysis of business incubators?	• What are the critical success factors for incubators-incubation? • How does the incubator-incubation concept work in practice? • How do incubators select incubatees?	• What is the process of new venture development in an incubator context? • What is the role of planning and the business incubator manager?	• Do incubators achieve what their stakeholders assert they do? • How can business incubation program outcomes be evaluated? • Have business incubators impacted new venture survival rates, job creation rates, industrial innovation rates? • What are the economic and fiscal impacts of an incubator?	• What is the significance of relationships and how do they influence entrepreneurship? • What are the critical connection factors to success, e.g., settings, networks, founder characteristics, group membership, co-production value, and creation process?" • What constitutes a model for a virtual incubator? • Is the network the location of the incubation process?

key topics, and main research questions are presented in Table I.

Incubator development studies

The goal of early incubator-incubation researchers was to accurately and/or normatively describe incubators. Key themes in incubator development studies include efforts at defining incubators-incubation, incubator taxonomies, and policy prescriptions. These themes are addressed below.

Defining incubators-incubation. Most research assumes that incubators are economic development tools for job creation whose basic value proposition is embodied in the shared belief that operating incubators will result in more start-ups with fewer business failures (Fry, 1987; Kuratko and LaFollette, 1987; Lumpkin and Ireland, 1988; Markley and McNamara, 1995; Rice, 1992; Udell, 1990). Despite the existence of this shared baseline assumption, definitional ambiguity *vis-à-vis* the terms "business incubator" and "business incubation" plagues the literature. This is problematic because, without precise definitions, it is difficult to ascertain the actual size of the incubator population to which systematic research efforts seek to generalize their findings. There are several sources of definitional ambiguity. First is the diffusion and repeated adaptation of the original business incubator concept in order to fit varying local needs and conditions (Kuratko and LaFollette, 1987). Second is the interchangeable manner in which the terms "Research Park," "Technology Innovation Center," and "Business

Incubator'' are used in the literature (Swierczek, 1992).[9] Third is the emergence of virtual incubators (also referred to as ''incubators without walls'') that endeavor to deliver business assistance services to incubatees who are not co-located within the incubator.[10] Fourth is a persistent tendency to not define the incubation process, or—when defined—to disagree on where and with whom the incubation process occurs.[11] Cumulatively, if left unaddressed, the above-mentioned sources of ambiguity in the terms and concepts of discourse will hinder efforts at generalizing incubator-incubation research results to the incubator population.

Early attempts at defining incubators-incubation are careful to draw out a distinction between incubators as real estate development efforts, and incubators as systematic business development-business assistance efforts (Brooks, 1986; Smilor, 1987b; Smilor and Gill, 1986). Highlighting this distinction in a normative description of incubators-incubation, Brooks (1986) describes a two-type incubator continuum where start-ups enter an ''economic growth incubator'' in order to gain access to the incubator's external support network, shared support services, and the resources of a local university affiliated with the incubator (Brooks, 1986). In this view, once the start-ups have attained a more advanced state of business development they can move into a ''real estate incubator'' which provides office space and shared services.

Brooks' continuum is adapted and elaborated by Allen and McCluskey (1990). They discard the notion that incubatees would move into a real estate property development incubator after achieving a critical mass, and instead focus on the primary and secondary objectives of four types of incubators that are distributed along a value-adding continuum. From least value-adding to most value-adding, these incubator types include For-Profit Property Development Incubators, Non-Profit Development Corporation Incubators, Academic Incubators, and For-Profit Seed Capital Incubators. The Allen and McCluskey continuum is reproduced in Figure 2.

While the goals and objectives of different incubator types may be indicative of the amount and type of resources that a certain type of incubator maintains, the varying goals and objectives among types of incubator depicted in the figure above may have little to say regarding the objectives of incubatees. Moreover, regardless of the stated goals and objectives of the incubator, ''the universal purpose of an incubator is to increase the chances of a[n incubatee] firm surviving its formative years'' (Allen and Rahman, 1985). Similarly, regardless of the incubator stakeholders' desire—and political need—to demonstrate the ancillary effects of job creation and economic development, the universal goal of incubatees is (or should be) to survive and develop as a corporate financial entity that delivers value to the owner(s)/shareholders. This point is often lost in practitioner debates and in politically charged discussions related to the initiation of incubator feasibility studies.[12]

As understanding of the incubator-incubation concept advanced, the concept that the incubator itself is an enterprise with its own developmental life cycle was embraced. The incubator start-up stage begins at the time a local community begins to consider establishing an incubator and ends once the incubator has reached full occupancy (Allen, 1988). The incubator business development stage is indicated by an increase in the frequency of interaction amongst incubator manager and incubatees, stable demand for space within the incubator, and greater support for the incubator in the local community (Allen, 1988). The incubator maturity stage reflects the point when the incubator has more demand for space than it can service and has become a center of entrepreneurial gravity in the community (Allen, 1988). The recognition of the incubator life-cycle is an important advancement. Specifically, it highlights the importance of would-be-incubatees performing due diligence on the incubator in order to determine whether the incubator has the core competencies in business assistance and the resources to provide the kind of value demanded by the venture's management team.

Incubator taxonomies. One of the great challenges of conducting incubator-incubation research is the difficulty of creating a control group of non-incubated companies whose developmental outcomes could then be compared to incubated companies (Sherman and Chappell, 1998). Ways

	Real Estate	Value-Added Through		Business Development
	For-Profit Property Development Incubators	Non-Profit Development Corporation Incubators	Academic Incubators	For-Profit Seed Capital Incubators
PRIMARY OBJECTIVE	Real estate appreciation Sell proprietary services to tenant	Job creation Positive statement of entrepreneurial potential	Faculty-Industry collaboration Commercialize university research	Capitalize investment opportunity
SECONDARY OBJECTIVE	Create opportunity for technology transfer Create investment opportunity	Generate sustainable income for the organization Diversify economic base Bolster tax base Complement existing programs Utilize vacant facilities	Strengthen service and instructional mission Capitalize investment opportunity Create good will between institution and community	Product development

Figure 2. Allen and McCluskey continuum (Allen and McCluskey, 1990).

to overcome this problem include adopting the use of matched pairs or comparing the performance of incubatees to the performance of a virtual incubator's incubatees (Bearse, 1998). In the literature, however, taxonomies of convenience are typically employed to create comparison groups. These taxonomies classify incubators on the basis of (a) the incubator's primary financial sponsorship[13] (Kuratko and LaFollette, 1987; Smilor, 1987b; Temali and Campbell, 1984), (b) whether incubatees are spin-offs or start-ups (Plosila and Allen, 1985), (c) the business focus of the incubatees (Plosila and Allen, 1985; Sherman, 1999), and (d) the business focus of the incubator (i.e. property development or business assistance) (Brooks, 1986) (see Table II). Despite the widespread use of these taxonomies, none of the studies reviewed demonstrated an ability to predict or explain variation in incubation outcomes—presumably the facet of the incubator-incubation phenomenon of greatest interest to researchers—on the basis of these taxonomic classifications.

Policy prescriptions. A number of incubator policy prescriptions offered in the literature are synthesized and analyzed here. These prescriptions appear multiple times in the literature but are drawn primarily from the following sources: (Allen and Weinberg, 1988; Brooks, 1986; Bruton, 1998; Campbell and Allen, 1987; Culp, 1996; Plosila and Allen, 1985).

First is the need for an advisory board to serve as an incubator ombudsperson. Because the incubator must make difficult incubatee selection decisions that require a sophisticated understanding of the market and the process of new venture formation, and because the incubator must rely upon political support from its advisory board in order to secure annual operating subsidies, the importance of a strategically constructed advisory board should not be understated.

Second, the rental income risk associated with the temporary tenancy of incubatees must be managed. Basically, cyclical demands for incubator space are somewhat mediated by the level of development and competencies attained by the

Table II
Taxonomies of incubators

Taxonomy	Representative citation
Incubator level: primary financial sponsorship[14]	(Kuratko and LaFollette, 1987; Smilor, 1987b; Temali and Campbell, 1984)
• Publicly-sponsored	
• Nonprofit-sponsored	
• University-sponsored	
• Privately-sponsored	
Incubator level: business focus	(Brooks, 1986)
• Property development	
1. Single tenant	
2. Multi-tenant	
• Business assistance	
1. Shared space	
2. Low rent	
3. Business support services	
Incubatee level: business focus	(Plosila and Allen, 1985; Sherman, 1999)
• Product development	
• Manufacturing	
• Mixed-use	
Type of incubatee	(Plosila and Allen, 1985)
• Spin-off	
• Start-up	

incubator and the current state of the entrepreneurial activities in the local community. With this in mind, pre-screened incubatees should be waiting in the admissions pipeline prior to the departure of current incubatees in order to optimize incubator rental revenue streams.

Third, a comprehensive menu of support services must be developed in order to be able to properly incubate the incubatees. Developing and offering a set of services—even if they are underutilized—may be significant, as the availability of the services may induce self-reflexive consideration on the part of incubatees as to what is required for their new venture to develop.[15]

Fourth, the qualitative difference between applicants for admission to the incubator and incubation candidates must inform the incubatee selection process. Specifically, because the incubator represents an attempt to help entrepreneurial new or young firms overcome some resource gap(s)[16] that prevent them from succeeding in their early stages of development, it is important from an economic rationality perspective to differentiate the types of applicants for admission to a business incubator in the following ways: (a) those that cannot be helped through business incubation, (b) those that should be incubated due to the existence of some resource gap(s) and (c) those that do not need incubation. Ideally, only those firms that are "weak-but-promising" (weak due to a lack of resources, but promising in the sense that they have built a compelling business case) should be considered incubation candidates.

Fifth, the degree to which incubators should/can assist incubatees with financial matters must be considered. Typically, most incubators do not maintain their own investment fund, serving instead as a broker that introduces incubatees to sources of capital when the need arises.

Sixth, while incubators are not an economic quick fix and while they have numerous limitations, they are an important component of a local economic development strategy and can serve a market failure bridging function by enabling entrepreneurship where previously it was too costly or too risky.

Finally, flexible oversight with dynamic readjustment of incubation programs as dictated by local needs is important for maintaining the vitality and effectiveness of the incubator in a cost-effective manner.

Key findings. In sum incubator development studies represent the earliest research conducted on the incubator-incubation phenomenon. These studies are characterized by efforts to define the incubator-incubation concept, to create taxonomic categories for comparison, and to provide policy guidelines for operating an incubator. While these efforts have several weaknesses that are discussed above, it is important to note that incubator development studies are novel exploratory, conceptual, empirical and normative attempts to render a very young phenomenon. Key findings in the early research on incubators amount to key descriptions that are useful for understanding the scope and nature of incubators. These findings are summarized in Table III.

Table III
Key findings from incubator development studies

Level	Representative citation
Community level • The incubator provides a protected environment in which new ventures—representing opportunities both for local economic expansion and investment—can develop. • Business incubators should be one element of a larger economic development strategy. • Net job creation through incubation is minimal, but not insignificant.	(Allen and Rahman, 1985; Campbell, 1989)
Incubator level • Incubators can be classified according to the nature of their primary financial sponsor or the business focus of the incubatees. • Low priced rent, shared-services, and the existence of entry/exit policies are key characteristics of incubators. • The incubator support network and university ties are key characteristics of incubators.	(Temali and Campbell, 1984; Plosila and Allen, 1985; Brooks, 1986)
Incubatee level • Charging the incubatees below market office space rent is important. • Incubatees assist one another, and sometimes purchase from one another. • Comprehensive business consulting services must be available to incubatees. • University technology business incubators have positive environmental effects on incubatees.	(Temali and Campbell, 1984; Allen and Rahman, 1985; Sarfraz A. Mian, 1994)

Incubator configuration studies

Early studies often describe the configurations of business incubators, examining the "design of the ... [incubator's] support arrangement, [and] describing facilities, budgets, organizational charts, geographical location, [and] institutional links" (Autio and Kloftsen, 1998) with a view to ascertaining the critical success factors of business incubation.[17] The emergence of these studies indicates the evolution of incubator-incubation science from an initial exploratory, fragmented understanding of the phenomenon to an increasingly holistic, systemic perspective. In order to better understand the development of this systemic view of the incubator-incubation concept, we examine subsets of configuration research that consider (a) incubator-incubation configuration frameworks, and (b) the incubatee selection component of the incubator system.

Incubator-incubation configuration frameworks. Several attempts have been made to conceptualize incubator configurations and, to a limited extent, the process of incubation. Building on the survey data collected in Temali and Campbell (1984), Campbell *et al.* (1985) develop a framework offering the first explicit linkage of the incubator-incubation concept to the business development process of incubatees (Campbell *et al.*, 1985). This framework, reproduced in Figure 3, suggests four areas where incubators-incubation create value: the diagnosis of business needs, the selection and monitored application of business services, the provision of financing, and the provision of access to the incubator network. Implicitly, with this framework, Campbell *et al.* have normatively defined the incubation process. This is useful because it suggests in detail, and for the first time, how different components of, and activities within, the incubator are applied to facilitate the transformation of a business proposal into a viable business. Weaknesses in the framework center on the failure to account for failed ventures (the framework assumes that all incubator tenants succeed) and the ascription of the framework to private incubators only.

In Figure 4 Smilor extends the Campbell *et al.* framework by elaborating various components (incubator affiliation, support systems, impacts of tenant companies) of the incubator-incubation concept. Unlike Campbell *et al.*, however, the

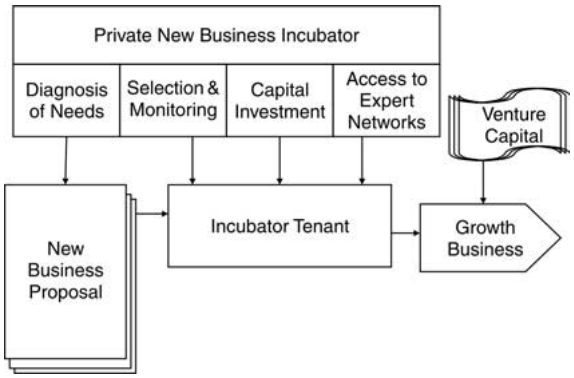

Figure 3. Campbell, Kendrick, and Samuelson framework (Campbell et al., 1985).

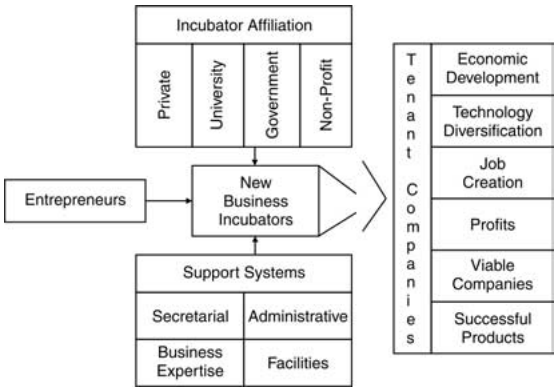

Figure 4. Smilor framework (Smilor, 1987).

Smilor framework takes an external perspective and fails to account for the incubation processes occurring internally. Utilizing data gathered from a national survey as well as from interviews, analysis of case studies, and observation, Smilor casts the incubator as a mechanism for reshaping the way that industry, government and academia interrelate (Smilor and Gill, 1986). He categorizes the benefits that incubators extend to their incubatees along four dimensions: (1) development of credibility, (2) shortening of the [entrepreneurial] learning curve, (3) quicker solution of problems, and (4) access to an entrepreneurial network (Smilor, 1987a). Smilor also conceptualizes the incubator as a system that confers ''structure and credibility'' on incubatees while controlling a set of assistive resources: ''secretarial support, administrative support, facilities support, and business assistance'' (Smilor, 1987b). Smilor's effort is perhaps the most comprehensive effort at identifying and explaining the various components of the incubation system.

Hisrich (1988) advances understanding of the incubator-incubation concept by locating the incubator within a complete continuum of innovation: The Enterprise Development Center (EDC) approach to incubation aggregates venture capitalists, student entrepreneurs, corporate intrapreneurs, the community (Tulsa) Innovation Center, the local Small Business Development Center (SBDC) and two local incubators (Hisrich, 1988). Hisrich asserts that localizing the design of an EDC based on cultural demands, having a highly placed champion to promote the EDC, establishing the EDC in a step-wise fashion with validation at each step, and educating private and public sector leaders about the EDC are critical success factors (Hisrich, 1988). Like Brooks (1986), Hisrich emphasizes the importance of incubating the community as much as servicing the needs of the incubatees. However, as with the Smilor framework, the Hisrich framework ignores internal incubation processes.

Configuring incubatee selection. Having specified the basic configuration of the incubator and conceptualized the incubator as a system, more intensive studies of the individual components of the incubator system were the next logical step in building the body of incubator-incubation research. Surprisingly, beyond Campbell *et al*.'s implicit definition of the incubation process and specification of the general configurations of incubators, little effort has been devoted to unpacking the variables associated with the incubation process. What work has been done in this area is generally limited to examining the process of selecting incubatees. Culp's (1996) position on the need to select what are essentially ''weak-but-promising'' companies has already been discussed above (see Policy prescriptions, p. 61). Lumpkin and Ireland (1988) use cluster analysis to categorize incubators on the basis of the selection criteria they employed when choosing

incubation applicants for admission to the incubator (Lumpkin and Ireland, 1988).[18] This research provides useful insights into the variability of selection criteria configurations across incubators and offers a new taxonomy, but the study does not suggest which configuration(s) are better or worse than others, nor does it attempt to link the analysis of selection criteria used with incubation outcomes.

Merrifield (1987) introduces a constraint analysis approach for selecting candidates for incubation. He grounds the approach in three questions, the first two of which are directed at the incubation applicant: "Is this a good business in which anyone should be involved?" "Is this a business in which [the applicant] organization has the competence to compete?" These questions form the basis for constructs that are operationalized on a number of items relating to business attractiveness and fit.[19] If a business is deemed attractive and a good fit, the incubator addresses the final question: "What is the best method for entry and/or growth?" In general, Merrifield's approach is sound. However, his emphasis on a firm's manufacturing capability being an integral factor in determining its fitness precludes the possibility of outsourcing. Additionally, his approach is somewhat overconfident, presupposing incubatee success to a degree that seems unrealistic.

Kuratko and LaFollette (1987) draw out one of the biases intrinsic to incubator-incubation research by positing that variability in the incubatee screening and selection process can lead to incubator and/or incubatee failure through the selection of ventures that do not merit incubation for either being too strong or too weak. This concept is elaborated upon by Bearse (1998) who draws a comparison between selecting incubatees and selecting students for admission to Harvard University. Specifically, Bearse asks whether Harvard students (the incubatees) succeed because of what Harvard (the incubator) does to them, or because Harvard selects only students who will succeed regardless of what Harvard does to them (Bearse, 1998). In the absence of a ready answer, scholars stress the importance of having a good "fit" between incubatee needs and the business assistance services that the incubator is capable of providing (Autio and Kloftsen, 1998).

Key findings. Incubator configuration studies are important efforts at drilling down into the incubator's infrastructure and operations in order to extend our understanding of the incubator-incubation concept. Although most of these studies are atheoretical, they help advance our knowledge of a very young phenomenon beyond the definitional level. Key findings from these studies are provided in Table IV.

Incubatee development studies

Little progress has been made toward understanding how incubatees develop within the incubator. This is not surprising, however, because a stream of literature on new venture development that centers on all new ventures (as contrasted with new ventures operating within incubators) exists within the domain of entrepreneurship research. We review here the few articles that focus explicitly on incubatee development.

Observing five clients of the St. Louis Technology Center, Scherer and McDonald (1988) generate six flowchart diagrams depicting the evolution of a new venture and conclude that clients benefit most when instructed to balance a "flexible capability for short-term adjustments to market feedback" with a long-term perspective. They caution against the new venture tendency toward unrealistic growth projections and ignorance of the need for operating funds. These findings are not novel, but they are useful in highlighting the fact that incubatees suffer the same shortcomings as their non-incubatee counterparts. More importantly they highlight the potential for incubator environments to generate passive interventions that create a layer of heightened strategic-reflexivity (i.e. a greater awareness of cause–effect relationships embedded within their activity sets) amongst incubatees.

Stuart and Abetti (1987) focus on the determinants of "initial success"[20] of a convenience sample of new and young ventures located in the Rensselaer Polytechnic Institute's Incubator Program and Technology Park. Measuring the impact of market, company and entrepreneur characteristics on initial success, the authors find a positive relationship between entrepreneurial characteristics and success, and negative relation-

Table IV
Key findings from incubator configuration studies

Key finding	Representative citation
Sources of value: incubator to community • Designed to cultural values of the community • Communication with community leaders	(Hisrich, 1988)
Sources of value: incubator to incubatee • Credibility • Diagnoses of business needs • Selection & monitoring • Access to capital • Access to network of experts/ support systems • Faster learning/solution to problems	(Campbell *et al*., 1985; Smilor, 1987; Autio and Kloftsen, 1998)
Sources of value: incubatee to community and incubator • Economic development • Technology diversification • Job creation • Profits • Viable firms • Successful products	(Smilor, 1987)
Critical success factors • Community 1. Community support 2. Entrepreneurial network 3. Entrepreneurial education 4. Tie to a University • Incubator 1. Perception of success 2. Access to finance 3. In-kind financial support 4. Selection & monitoring for incubatees 5. On-site business expertise 6. Milestones with clear policies & procedures • Incubatee 1. Business attractiveness 2. Perception of success	(Smilor, 1987; Campbell *et al*., 1985; Merrifield, 1987)
Incubatee selection process is important	(Culp, 1996; Lumpkin and Ireland, 1988, Merrifield, 1987; Kuratko and LaFollette, 1987, Bearse, 1988)

ships between market dynamism, R&D intensity, organic nature of the firm and success. They interpret their findings as indicative of a need for entrepreneurs to maintain tight, centralized control over their ventures.

Fry (1987) conducts a census of the members of the NBIA to examine the variance among incubatees' intensity of planning activities. A comparison group of companies affiliated with a SBDC is used in an effort to parse out differences between incubator tenants and non-tenants. However, because incubator managers were the respondents to questions on the perceived use of planning amongst incubatees, a statistical comparison with the self-reported responses of SBDC-affiliated companies is not meaningful. Ignoring this point, Fry concludes that incubatees are "more active planners" than non-incubatees and argues that results imply that incubator managers should actively encourage planning activities among incubatees.

Although his attempt at overcoming the difficulty in creating a comparison group for experimental research is novel, it seems likely that Fry is comparing different types of ventures. Although there is no empirical research to support the contention that SBDC-affiliated firms are lower in potential than are incubatees co-located within an incubator, normatively and intuitively this assumption seems accurate: The non-profit incubator is established as a "public-private" engine of economic development whose incubatees are selected in the expectation that fostering their success will help fuel local economic growth. Alternatively, free-standing SBDCs (i.e. SBDCs that do not provide rental office space and that are not integrated into the local innovation development continuum in the manner described in the Hisrich Framework) are purely government-operated programs that provide general advice to any individual(s) seeking to establish a new venture. The typical SBDC customer seeks to establish a lifestyle venture (i.e. a venture that is built slowly over time in order to replace income from a currently held job). Our perceived relationship amongst types of entrepreneurial ventures and support agents is depicted in Figure 5 below. However, empirical testing should be conducted before unreservedly adopting this perspective.

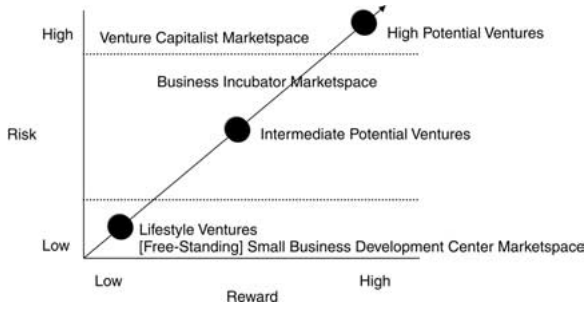

Figure 5. Types of entrepreneurial ventures and corresponding support agent marketspace.

Key findings. Incubatee development studies are rather underdeveloped and probably will remain so due to the difficulty of obtaining data from early stage ventures regardless of whether the venture is located within an incubator. Nonetheless, key findings from this area of research include the importance of providing dynamic, proactive feedback to incubatees, assisting incubatees with business planning, and encouraging incubatees to introduce control systems during the early stages of incubatee development.[21]

Incubator-incubation impact studies

When considering incubator-incubation impacts, the fundamental research question is "Does the operationalized incubator-incubation concept make any difference in the survival rates of incubatees?" In our review, we found one study that addresses this question squarely: An exploration of the relationships between incubator structure, services and policies and incubatee survival found that more than half the variation in outcomes was explained by the age of the incubator (a proxy for level of development of the incubator) and the number of incubatees (Allen and McCluskey, 1990). This suggests that the stocks and flows of new venture development-related knowledge accumulated and channeled by the incubator over time (i.e. organizational learning) may be the most important variable for incubating new ventures. Additional incubator-incubation impacts of interest include the number/rate of new start-ups created, the number/rate of corporate start-ups created, and the number/rate of new jobs created (Udell, 1990). Most impact studies that measure these items do so by tabulating simple running counts for each metric.[22] The subsections below review literature that studies the impacts of various variables of incubators-incubation in terms of "success" and economic impacts.

Measures of incubator success. Campbell and Allen (1987) offer the following "milestones" as measures of incubator success (Note: "tenant" means incubatee in our context):

> Creation of a responsive business consulting network, participation of financial intermediaries in tenant capitalization, the point at which a majority of tenants are start-up firms as opposed to previously existing small businesses, and the synergism that occurs when tenants develop trade relations with one another such as subcontracting and joint purchasing. (Campbell and Allen, 1987, p. 189)

Measures of the above aspects are also indicators of the incubator's level of development, as are the sustainability and growth of the incubator, the scope and effectiveness of incubator management policies, and the ability to provide comprehensive services (Mian, 1997). The degree of fit between the business incubation services offered by the incubator and the needs of the local market is another measure of incubator success (Autio and Kloftsen, 1998). Drawing from the performance benchmarking literature, Bearse (1998) suggests that if data is regularly collected and made available, an incubator could also measure its success in comparison to other incubators on a variety of operational and outcome measures and against a business incubator industry baseline

(Bearse, 1998). Despite efforts by the NBIA such data has proven difficult to gather and maintain on an ongoing basis.

Measures of incubatee success. The simplest measure of incubatee success is "graduating" from the incubator upon overcoming resource gaps and developing sustaining business structures. Indeed, in the literature incubator success has been defined as a ratio expressed in the following terms: Number of Firms Exiting the Incubator::Number of Firms Discontinuing Operations While Still a Tenant (Allen and Weinberg, 1988). Beyond this simple measure, firm growth and development measures have also been applied to the incubatees. Growth measures include examining increases in number of jobs or sales over time, while development measures are reflected in "product innovation, quality of the management team, and strategic alliances consummated" over time (Bearse, 1998; Udell, 1990).

Incubator variables associated with incubatee success. Incubator variables that have been posited to be associated with incubatee success include incubatee selection processes (Kuratko and LaFollette, 1987; Merrifield, 1987), internal incubator network formation (Lichtenstein, 1992), incubator-industry network and incubator-support services network density (Hansen *et al*., 2000; Nowak and Grantham, 2000), incubator manager–incubatee relationships (Autio and Kloftsen, 1998; Fry, 1987; Rice, 2002; Sherman, 1999; Udell, 1990), incubator effectiveness (Sherman and Chappell, 1998), level of incubator development (Allen, 1988; Sherman and Chappell, 1998), and procedural standardization and policy formalization (Bearse, 1998). However, few of these relationships have been empirically tested. While most practitioner studies find a high rate (usually over 80%) of incubatee survival (Bearse, 1998), other studies report less optimistic (55%) survival rates (Roper, 1999). When examining incubatee survival rates, however, direct comparisons with non-incubated ventures' survival rates may not be meaningful as the use of selection criteria in admitting incubatees to the incubator results in a selection bias (Sherman and Chappell, 1998).

Community economic impacts. Despite the indefatigable and politically correct belief of incubator managers and government officials that incubators create jobs, early empirical research suggests that incubators and their incubatees are not very good job creators (Campbell and Allen, 1987). However, business incubators have been found to be more cost-effective economic development tools than programs to attract firms to local regions (Markley and McNamara, 1995; Sherman, 1998, 1999; Sherman and Chappell, 1998).

Key findings in the incubator-incubation impact studies. There are three key findings in the incubator-incubation impact studies (see Table V). First, the level of incubator development and the number of incubatees are positively related with incubatee survival. Second, incubators represent a lower cost means to job creation than cost-sharing corporate relocation programs. Third, the area of incubator-incubation impact research is surprisingly understudied and represents fertile ground for future research.

Theorizing about incubators-incubation

In this section, we review theoretical approaches to explaining the incubator-incubation concepts that appear in the literature. Given the newness of the field, it is not surprising that much of the literature is exploratory and descriptive with little attention devoted to theory-building. However, to quote Weick, "What theory is not, theorizing is" (Weick, 1995), and some, but not many, implicit and explicit efforts at theorizing about incubators-incubation can be found in the literature.

Early theorizing. The incubator development studies that address the question of "What is an incubator?" are implicitly engaged in descriptive

Table V
Key findings from impact studies

Key finding	Representative citation
Community level • Incubators are not good job creators, but... • Incubators are more cost-effective than programs to attract firms to a region.	(Campbell and Allen, 1987; Sherman, 1999)
Incubator level • There are many proposed incubator measures that range from simple (sustainability) to the more complex (fit). ... • Unfortunately, there are few empirical results.	(Campbell and Allen, 1987; Bearse, 1998)
Incubatee level • As with incubator impact measures, there is a wide spectrum of measures, most with no empirical support.	(Udell, 1990; Bearse, 1998)

and normative theorizing about the incubator-incubation concept. The first formal hypothesis ventured regarding incubators is as follows:

> Once extraneous factors that lead to early stage failure of small businesses (poor management, inability to find early stage financing, high overhead, etc.) are controled or eliminated, the projected increased survival rate of new ventures should lead to increased employment and an expanded tax base. (Brooks, 1986, p. 24)

This hypothesis is grounded in the "theory of economic development through entrepreneurship" which posits that the entrepreneurial process of conceiving new business concepts and then instantiating new firms based on these new concepts is the basis of economic growth (Brooks, 1986). This theory is used to address the gap that occurs between conceiving the new business concept and actually instantiating the firm.[23] Brooks contends that the incubator and the incubation process are used to narrow this gap. Another perspective on bridging the gap can be found in transaction cost economics (TCE). In the TCE view a firm gains competitive advantage by relentlessly reducing the costs of doing business (Williamson, 1978). From this perspective the primary function of the incubator is to bridge the gap by reducing the start-up and other operating costs of incubatees by providing shared office space and services at low cost. This frees the incubatee management team to focus on building the business. A related hypothesis suggests that incubators are

> designed to help entrepreneurs develop their business ventures in a supportive business environment. Without the incubator most of the entrepreneurs would either not be in business or struggle to remain in business. (Plosila and Allen, 1985, p. 732)

This hypothesis is essentially a market failure argument and is complemented by research that views incubators as mechanisms for enabling a firm "to master the competitive factors linked with effectiveness within particular industry settings" (Lumpkin and Ireland, 1988). While such assumptions are both intuitively compelling and difficult to disprove, many incubatees report that they would have established their firms even if the incubator did not exist (Culp, 1996). This should not necessarily be taken as evidence against the incubator-incubation concept, however, as the confidence required to launch a new venture may also be associated with unreasonable levels of confidence regarding personal capabilities and success (Nye, 1991).

Structural contingency theory. Although the incubator configuration studies were atheoretical, inductive compilations of variables of the incubator-incubation phenomenon, implicitly this

approach rests on structural contingency theory. The primary assumption of structural contingency theory is that the configuration of an organization and the external environment must achieve "fit" in order to obtain "success" (Ketchen *et al*., 1993). Although most configuration studies do not test for success, structural contingency theory provides a theoretical underpinning for the often asserted need for the incubator to be tailored to meet local needs and norms.

Interdependent co-production modeling. Rice (2002) explicitly grounds the collaborative incubator manager–incubatee relationship in the interdependent co-production equation.[24] This equation models the co-creation aspects of the value-adding incubation process. It suggests that the time intensity of business assistance interventions must be strategically allocated by the incubator manager to the incubatees, and that incubatees must be properly prepared to utilize the advice and insights resulting from the intervention. This perspective is important because it calls our attention away from the incubator facility and toward the incubation process. It also reminds us of the importance of properly assessing the core competencies of the incubator before entering the incubator and determining whether the incubator and incubatee are a good fit. If there is no fit, the interdependent co-production may result in the co-creation of inappropriate, value subtracting incubation processes.

Network theory. Commercialization usually occurs within an innovation community rather than a single organization (Lynn *et al*., 1996). Hansen *et al*. (2000) employ network theory (Nohria and Eccles, 1992) to argue that primary value-added feature of networked incubators is the set of institutionalized processes that carefully structure and transfer knowledge throughout the incubator network in order to create conditions that facilitate the development of incubatees and the commercialization of their innovations. They find that degree of entrepreneurial intensity, economies of scale and scope, and network design are important factors for incubation success. The importance of the network design factor is supported by research that concludes that network relationship-building is the most important value-added component of the incubation process (Lichtenstein, 1992). Network theory is also useful because it handily addresses the debate regarding the location of the incubation process: Rather than locate the incubation process either inside the incubator or in the local community, network theory asserts that the incubation process includes and transcends the incubator.

Virtual incubation: Middleman, enclave, and collective theories. Middleman theory finds its roots in Weber (1993) and describes a condition in which a resourceful minority group systematically develops a brokering position in a specific industry or industries. Enclave theory locates the spatial positioning of middleman enterprises in a specific cluster. Collective theory describes a form of group-based economic endeavors in contrast to "lone-wolf" entrepreneurs. Greene and Butler (1996) explore the phenomenon of virtual incubators by drawing on these three lenses. They assert that a virtual incubator drives the entrepreneurial processes among a group of ethnically distinct minority immigrants who consciously position themselves as brokers in a discrete location and work to improve and expand the business achievements of one another.

Also theorizing about virtual incubation, Nowak and Grantham (2000) focus on flows of knowledge in the software industry. They contend that because leading edge software industry knowledge is geographically distributed and embedded within practices, a virtual incubator is needed to foster the development of information-intensive new software ventures through information dissemination (Nowak and Grantham, 2000). This argument suggests a growing importance in the roles of knowledge brokering and the market-space for ideas (Gans and Stern, 2003).

Key findings. There are several key findings related to studies theorizing about the incubator-incubation concept. First, from a TCE and market failure perspective, incubators are a systematic approach to controlling resources and

reducing costs during the early stages of a venture's development. Second, the incubator configuration must meet local needs and norms. Third, the process by which the incubation system is managed and created is a collaborative effort between the incubator manager and the incubatees. Fourth, the time duration and intensity of incubator manager intervention, coupled with the breath, readiness and fit of the incubator manager–incubatee dyad impact the success of the incubatee. Fifth, network relationships and institutionalized knowledge transfers enhance the likelihood of incubation success.

4. Challenges within extant research

In this section, we review the challenges identified within extant research and suggest new avenues for future research. Specifically, we note the need for future research to address the lack of convergence in the terms and concepts of discourse related to incubators-incubation, the lack of theoretically meaningful incubator classifications, the lack of a business incubation process model, the long-standing challenges in the definition and measurement of incubator-incubation-incubatee "success," and the need for deeper theorizing about incubators. Key findings in the literature and our analyzes summarizing the challenges within extant research are presented in Table VI.

Defining terms and concepts

Most researchers agree that incubators-incubation represent a systematic method of providing business assistance to firms in the early-stages of their development. Assistance is provided with the aim of increasing firm survival rates. Beyond this common baseline assumption, however, definitional and conceptual heterogeneity have made defining the scope and boundaries of the phenomenon as well as the development of a set of axiomatic statements related to the phenomenon rather challenging. Accordingly, in lieu of incubator-incubation theory, research has produced catalogs of incubator configurations listing the factors associated with various conceptualizations of incubator-incubation "success". If incubator-incubation research is to advance in a scientific manner, a convergence upon a single definition that accounts for the scope and boundaries of the incubator-incubation phenomenon is required. With our formal definitions in this section we have advanced definitions that we believe are suitable for anchoring theory-building research.

Incubator classifications: taxonomies vs. typologies

The taxonomies of convenience that have been employed in the literature thus far have not been useful with regard to explaining variation in incubation outcomes. Prior research (Allen and McCluskey, 1990; Rice, 2002) suggests that more meaningful classifications may be created by focusing on items such as the competencies of the incubator, the incubator's level of development, and the incubatees' level of potential. Theoretically grounded and tested typologies that use these metrics have the potential to be much more useful for future research than extant taxonomies.

It bears noting that over time a number of the early entrants into the for-profit incubator space, as well as many of the NASDAQ bubble-era for-profit incubator entrants have exited the incubation industry. This not only raises questions about the utility of using incubator primary financial sponsorship and profit-orientations as meaningful comparison categories, it also raises questions regarding the long-term sustainability of for-profit incubator models. Perhaps the non-profit incubator—with its relatively lower fixed costs and expectations—might represent a better, more politically rational model for allocating community resources and demonstrating the community's long-term commitment to facilitating economic development through entrepreneurship. In this view the politically mediated infusion of public resources into the incubator on an annual budget review basis and at levels roughly analogous to current economic cyclical demands also has a certain logic.

Table VI
Key findings and analyses of incubator-incubation literature

Incubator development studies Key findings	Incubator configuration studies	Incubatee development studies	Incubator-incubation impact studies	Studies theorizing about incubators-incubation
• Incubators are normatively and empirically defined but without convergence across studies.	• Most incubators use a mix of factors, reflecting differing perspectives. • Incubators with an entrepreneurial environment, economies of scale and network access are more likely to have successful incubatees.	• Proactive development is an important factor in incubatee growth	• Selection is an important characteristic of incubatee success • Universities can provide a resource base and environment to foster the commercialization of university inventions. • Development and job creation via incubators are more cost effective than attracting existing firms to a new community. • Capacity to benchmark and evaluate incubators-incubation is important. • Reducing risk and improving survival rates and growth rates of incubatees is a more common outcome than job creation. • Incubator manager plays a central role in the incubation of new ventures.	• From a TCE and market failure perspective, incubators are a systematic approach to controlling resources and reducing costs during the early stages of a venture's development. • Incubator manager plays a central role in the incubation of new ventures.Incubator configuration must meet local needs and norms. • The process by which the incubation system is managed and created is collaborative effort between the incubator manager and the incubatee. • Network relationships and institutionalized knowledge transfers enhance the likelihood of incubation success. • Time and intensity of incubator manager intervention, coupled with the breath and readiness of incubatee manager, impact the success of the incubatee.
Needs • Need to obtain greater definitional and conceptual convergence in future research.	• Need to shift focus from incubator configurations to explanations of how and why the components work together.	• Need to develop a process model to explain how and why the incubation process facilitates incubatee development.	• Need to conduct research that addresses whether incubators-incubation impact new venture survival rates.	• Need to develop explicit theory of business incubation.

Business incubation process model

Despite the fact that the NBIA has noted on many occasions that the incubation process is much more important than the incubator facility (Adkins, 2001), the extent of what we know about the incubator-incubation phenomenon is limited almost exclusively to the incubator facility. As interest in entrepreneurship continues to grow, interest in methods for increasing the likelihood of entrepreneurial success and preventing entrepreneurial failure will also continue to grow. Accordingly, the development of models of the incubation process represents an opportunity to conduct incubator-incubation research that is likely to be of interest to a much broader spectrum of researchers than studies on incubator facilities. To facilitate a focus on incubation process studies, a moratorium on incubator facility configuration studies should probably be imposed.

Measures of "success"

The attempt to measure the impacts of incubators-incubation is as important as it is challenging. Measurement is important because most incubators operate with public funds and should be held accountable for the outcomes associated with the use of those funds. Measurement is challenging because the full range of data required to implement experimental research designs that squarely address the question "If the incubatee had not been incubated, would there be any difference in the survival rate of new ventures?" is not readily available. Specifically, data on successful incubatees is relatively easy to obtain because incubators tend to promote their own incubation success stories. Data related to failed incubatees is somewhat more difficult to access as incubation failures may carry political implications that can result in a decrease or elimination of operating subsidies. Data on the success and failure of comparable non-incubated companies is rarely kept and has proven quite difficult, if not impossible, to obtain (Bearse, 1998).

Below, we briefly identify the levels and units of analysis available to incubator-incubation researchers in order to better understand what kind of variables can be measured in future research efforts.

Levels and units of analysis. Specifying the level of analysis employed helps to limit the scope of an investigation by focusing the research efforts. Figure 1 indicates the multiple levels of analysis employed in incubator-incubation research. Here we list all possible levels of analysis in incubator-incubation research with the corresponding generic management research label given in parentheses as a guide for future research efforts: Entrepreneur (individual) level, incubator manager (individual) level, incubatee (group/firm) level, incubator (firm) level, community (local) level, and incubation industry (industry) level.

Specifying the unit of analysis is critical for creating any research design. The range of potential units of analysis in incubator-incubation research includes (a) the community in which the incubator operates, (b) the incubator as enterprise, (c) incubator manager, (d) incubatee firms, (e) incubatee management teams, and (f) the innovations being incubated.

Measures of success. The paucity of peer-reviewed incubator-incubation impact studies that measure success suggests a need for more research in this area. Interestingly, to justify a renewal of funding arrangements for the incubator, most incubation industry stakeholders prepare annual incubation performance reports. In these reports, the incubator is often the unit of analysis while a running count of incubation outcomes—measured in terms of incubatee job growth, incubatee financial performance, and incubatee developmental advances at the time of incubator exit—provides measures of the incubator's performance. Cooperation among researchers and practitioners may result in an increase in studies that report incubator-incubation impacts accurately and meaningfully for both groups. This is not trivial: The level, scope and quality of incubation-related data management varies widely among incubators and access to information regarding politically sensitive incubation failures will continue to remain problematic. Accordingly, in addition to measures reviewed in the body of this article, we encourage practitioners and researchers who seek to measure the incubator's performance on the basis of incubatee performance to capture incubation outcomes as

temporary states that are relatively politically safe but also meaningful. Operationally, we believe there are five different mutually exclusive incubatee outcome states at the completion of the incubation process:

- The incubatee is surviving and growing profitably.
- The incubatee is surviving and growing and is on a path toward profitability.
- The incubatee is surviving but is not growing and is not profitable or is only marginally profitable.
- Incubatee operations were terminated while still in the incubator, but losses were minimized.
- Incubatee operations were terminated while still in the incubator, and the losses were large.

Current approaches to conceptualizing incubators-incubation and the praxis of incubator-incubation management suggest that the first three outcome states are indicative of incubation success while the last two outcome states indicate incubation failure. It must also be noted that the first three outcome states represent only a snapshot of the incubatee's performance on "graduation day" and are no guarantee of future success or failure.

Theory development

The current body of research describes for us the "what" of the incubator-incubation phenomenon. Specifically, we have accumulated a number of empirical and normative descriptions of the factors that should be included in attempts at explaining this phenomenon. However, most of this research is atheoretical (Mian, 1994; Mian, 1996), and theory is the lifeblood of any research area. If the area of incubator-incubation research is to advance in a theoretically meaningful manner beyond simple lists of critical success factors, then we must turn our attention from "what" are the important factors to "how" and "why" and "in what context" ("who" "where" and "when") these factors are interrelated. Finally, the long term viability of incubator-incubation research depends not only on grounding future research in theory and developing new theory, but also on demonstrating why incubators are intrinsically, theoretically compelling.

5. Conclusions

In this systematic review, we have synthesized and analyzed concepts, empirical findings, and problems related to extant incubator-incubation research using, as our organizing guide, the five primary research orientations along which the literature has evolved. Although a significant body of research has developed in the years since Temali and Campbell (1984) set the standard for describing incubators and their configurations, it is clear that research has just begun to scratch the surface of the incubator-incubation phenomenon. While much attention has been devoted to the description of incubator facilities, less attention has been focused on the incubatees, the innovations they seek to diffuse, and the incubation outcomes that have been achieved. As interest in the incubator-incubation phenomenon continues to grow, new research efforts should focus not only on these under-researched units of analysis, but also on the incubation process itself. Indeed, for our understanding of the incubator-incubation phenomenon to advance, we will need to unpack the variables associated with the incubation process and then use these variables to build, validate and test incubation process models that help predict and explain clearly defined business incubation outcomes. Focusing on the process of incubation rather than on the incubator facility and its configuration will draw attention to the underlying causes of new venture development in an incubator-incubation environment. This, in turn, should lead toward theories of business incubation. The path to such theory development undoubtedly will entail multiple research methods, and will require researchers to draw from theories that are used in other research domains. In particular, future research may benefit by drawing from the rich set of theories that are used to explain phenomena associated with new venture formation and development, new product conceptualization and development, and business assistance.

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Notes

1. We offer our thanks to the anonymous reviewers and colleagues who suggested that we review articles on incubators-incubation appearing in *Academy of Management Review, Academy of Management Journal, Administrative Science Quarterly, Management Science*, and *Strategic Management Journal*. Articles explicitly focused on incubators-incubation have not been published in these journals.
2. Alternative definitions culled from our review of the literature can be found in Appendix C.
3. Established in Philadelphia in 1963, the UCSC is a consortium of 30 academic and scientific institutions billed as the U.S.'s largest urban research park.
4. E.g. CIE (1984); SBA (1985).
5. E.g. Allen *et al*. (1984); Das and Ferill (1985); Dorf and Purdy (1985); Erdy (1985); Lavelle (1986).
6. For examples of the popular press' disenchantment with (mostly for-profit) incubators see the following articles: Drake (2001); Duvall and Guglielmo (2000); Enrado (2002); Finer and Holberton (2002); Holson (2000); McGinn (2002); Nocera (2001); Schaff (2000).
7. The National Business Incubation Association's most recently available figures indicate that 75% of incubators are non-profit.
8. Udell (1990) and Bearse (1998) are particularly insightful in their criticism of self-reported measures of success provided by incubators.
9. In principle, a research park (a.k.a. a science park) is a location for the conduct of basic research; a technology innovation center is a location for commercializing the results of basic research; and a business incubator is a location for fostering the development of new or young businesses. In practice, a great deal of convergence amongst these three organizational forms has emerged; differences are in scale of operations and expectations *vis-à-vis* outcomes.
10. The emergence of virtual incubators is problematic because it is questionable whether they can be considered "bona fide" (Bearse, 1998) incubators. If they can be considered incubators, then implicitly any entity that provides business assistance services can also be considered an incubator. This significantly increases the population and heterogeneity of incubators, constraining our ability to generalize research findings. Because we view the environment inside the incubator—including the effects generated by the aggregation and interaction of entrepreneurs from different start-ups co-located inside the incubator—to be an important facet of the incubator-incubation phenomenon, for academic definitional purposes we advocate viewing virtual incubators as intervention programs rather than as business incubation programs.
11. Campbell *et al*. (1985) are the rare group of scholars who attempt a definition, defining the value-adding process of incubation as follows: "(1) The diagnosis of the total business needs of a new business, from the collective experience of a diverse group of business generalists and specialists. (2) The cost-effective selection, provision and monitoring of the acquisition, implementation and coordination of the various business services needed by the new business. (3) The provision of capital—if needed—to pay for product development and the business services provided by third party professionals. (4) The provision of a growing network of business development expertise". They locate this process inside the incubator. Alternatively, Brooks (1986) identifies the incubation process as a set of activities occurring in the community where the incubator is located. These activities include educating members of the community regarding the theoretical benefits of entrepreneurship and demonstrating the benefits of launching entrepreneurial ventures.
12. The average incubator start-up costs approach $1,000,000 (Bearse, 1998) and incubator proponents tend to overemphasize the ability of the incubator to "create jobs" as a justification for the large initial capital expense. Readers interested in learning how to conduct an incubator feasibility study should see the following: Bazan (1987); Meeder (1993).
13. See the Allen and McCluskey (1990) continuum for more insight on the types of primary financial sponsors.
14. "Publicly-sponsored" business incubators benefit from national and state-government funding sources, while non-profit-sponsored business incubators benefit from local or community level funding sources. "University-sponsored" business incubators are funded and operated directly or indirectly by a university. "Privately-sponsored" business incubators are self-funded and are operated in a fashion that resembles hands-on venture capitalists' involvement in venture investments. They can be run by private investor groups, or by the new venture development units of corporations. In the past some corporations have developed incubator franchises.
15. Rice (2002) elaborates in some detail the passive intervention effects associated with incubators-incubation.
16. Resource gaps can include, for example, a lack of access to information, a lack of access to potential customers, a lack of expertise required to complete new product development, a lack of access to expensive equipment, or a lack of access to funding sources.
17. See for additional examples: Brooks (1986); Campbell *et al*. (1985); Lumpkin and Ireland (1988); Smilor (1987b); Temali and Campbell (1984)
18. Categories they identified include Experience of the Management Team, Financial Strength, Market Related Factors, and No Selection Criteria.
19. Merrifield uses items related to include finance, legal, regulatory, manufacturing, management, marketing, distribution, and technology factors.
20. Initial Success is decomposed as Initial Quantified Success (Sales Growth, Employment Growth, Profitability, ROE, Sales/Employee, Sales/Assets) and Initial Subjective Success (Original Expectation, Attainment, Probability of Survival, Ability to

Attract Outside Capital, Employee Satisfaction, Contributions to Society).

21. Because, by definition, incubatee development studies are only at the incubatee level, using the dimensions of community and incubator to examine key findings would not be meaningful here.

22. See, for example, Allen and Rahman (1985); Hansen *et al.* (2000); Markley and McNamara (1995); Safraz A. Mian (1994); Roper (1999); Sherman (1999); Smilor (1987b); Temali and Campbell (1984)

23. This gap has been referred to elsewhere as the "Valley of Death" (Branscomb and Auerswald, 2002).

24. $Q = cRP^{d}CP^{e}$: Q = value-added output (incubation process); c = a scaling factor; RP = regular producer (incubator manager) inputs; ^{d} = output elasticity; CP = consumer producer (incubatee) inputs; ^{e} = output elasticity.

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Appendix A: List of studies reviewed

Articles

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Appendix B: Distribution of research perspectives applied to incubator-incubation studies

Research perspective	Frequency	Citations
Economic development	18	(Allen, 1988; Allen and McCluskey, 1990; Allen and Rahman, 1985; Allen and Weinberg, 1988; Brooks, 1986; Campbell, 1989; Campbell and Allen, 1987; Campbell *et al*., 1985; Hisrich, 1988; Markley and McNamara, 1995; Merrifield, 1987; Plosila and Allen, 1985; Sherman, 1999; Sherman and Chappell, 1998; Smilor, 1987b; Swierczek, 1992; Temali and Campbell, 1984; Udell, 1990)
Critical success factors	5	(Hansen *et al*., 2000; Lichtenstein, 1992; Lumpkin and Ireland, 1988; Scherer and McDonald, 1988; Smilor, 1987b; Stuart and Abetti, 1987)
New venture creation/development	3	(Udell, 1990) Hisrich, 1988 #726](Scherer and McDonald, 1988)
New technology based firms (NTBFs)	3	(Mian, 1994a; Mian, 1994b; Mian, 1996)
Public policy	2	(Allen and Weinberg, 1988; Plosila and Allen, 1985)
Planning studies	2	(Fry, 1987; Lumpkin and Ireland, 1988)
Entrepreneurship	2	(Bruton, 1998; Hisrich, 1988)
New product development	2	(Scherer and McDonald, 1988; Udell, 1990)
Organizational effectiveness	2	(Mian, 1996; Mian, 1997)
Small business studies	1	(Fry, 1987)
Life cycle models	1	(Allen, 1988)
Value-added	1	(Campbell, 1989)
Network theory	1	(Lichtenstein, 1992)
Technology development	1	(Mian, 1994a; Swierczek, 1992)
Economic rationality	1	(Markley and McNamara, 1995)
Innovation theory	1	(Culp, 1996)
Technology transfer	1	(Culp, 1996)
Middleman theory	1	(Greene and Butler, 1996)
Enclave theory	1	(Greene and Butler, 1996)
Institutional perspective	1	(Greene and Butler, 1996)
Business incubation support	1	(Mian, 1997)
University technology commercialization	1	(Mian, 1997)
SME support	1	(Autio and Kloftsen, 1998)
Performance benchmarking	1	(Bearse, 1998)
Impact assessment	1	(Roper, 1999)
Cost effectiveness	1	(Roper, 1999)

Note: Many studies employed multiple frameworks. $N = 38$.

Appendix C: List of definitions culled from the literature

(Allen and Rahman, 1985)

"A small business incubator is a facility that aids the early-stage growth of companies by providing rental space, share office services and business consulting assistance."

(Plosila and Allen, 1985)

"A small business incubator is a facility which promotes the early stage development of a for-profit enterprise."

(Brooks, 1986)

"A multi-tenant facility which provides entrepreneurs with: (1) flexible leases on small amounts of inexpensive space; (2) a pool of shared support services to reduce overhead costs; (3) some form of professional and managerial assistance; and (4) access to or assistance in acquiring seed capital."

(SBA, 1986) in (Udell, 1990)

"Buildings in which a number of new or growing businesses can locate and operate at much lower costs than in conventional space where market rates prevail. Incubator facilities are characterized by access to shared, centralized facilities such as clerical and administrative help, receiving and shipping facilities, conference rooms, computers, and word processors, and other business assistance."

(Smilor and Gill Jr., 1986)

"By controlling [four types of resources: secretarial support, administrative assistance, facilities support, and business expertise including management, marketing, accounting, and finance . . . "]
. . . the business incubator seeks to effectively link talent, technology, capital, and know-how in order to leverage entrepreneurial talent and to accelerate the development of new companies."

(Kuratko and LaFollette, 1987)

"Reducing the rate of failure in small business by assistance in the critical stage of business development—the early years."

(Smilor, 1987b)

"A new business incubator is an innovative system designed to assist entrepreneurs, particularly technical entrepreneurs, in the development of new firms."

(Campbell and Allen, 1987)

"An incubator [is a] building, section of a building, or adjacent buildings that provide a nurturing environment to . . . assist in the growth and development of new enterprises."

(Fry, 1987)

"The business incubator is a new concept in entrepreneurship and economic development which utilizes large, often old, building to house new small businesses. The unique aspect of incubators is that the businesses share administrative services in addition to renting space in the building. Typically, the incubator provides clerical and receptionist staff, computer and copying equipment, accounting/bookkeeping help, and conference rooms. Management assistance is generally provided by either the incubator staff or outside consultants, and financing is often available."

(Merrifield, 1987)

"They [business incubators] provide secure, affordable, flexible, well equipped space in which the entrepreneur can work (often day and night).

They [business incubators] provide readily accessible support services (receptionist, clerical, data processing, copying, legal, accounting, machine shop, conference, fast food and other capabilities).

They [business incubators] provide professional business management and technical consulting, together with access to seed and working capital, state and federal grants, loan financing, venture capital and R&D Limited Partnership (RDLP) funding, public and private stock offerings, and state equity financing.

They [business incubators] often are associated with a university that can provide additional access to highly specialized analytical, computing and test facilities in an array of disciplines.

They [business incubators] create an interactive community of entrepreneurs; academic and business interests that stimulate and encourage the sometimes fragile business incubation process.

They [business incubators] often operate as a communications bridge with the community, and established enterprises that seek a window on emerging technologies and may provide growth capital for equity participation."

(Lumpkin and Ireland, 1988)

"Business incubation is an organized effort to bring together new and emerging businesses in a controlled environment."

"The main objective of a business incubator is to facilitate development of conditions and support systems that will ensure successful business operations."

(Hisrich, 1988)

"By providing a variety of services and support to start-up and emerging companies, the incubator seeks to effectively link talent, technology, capital, and know-how to leverage entrepreneurial talent, accelerate the development of new companies, and thus speed up the commercialization of technology."

(Campbell, 1989)

"Business incubators are 'change agents' in the transformation of our economy from one that is based on large manufacturers to one with many new, small 'information age' firms. Business incubators address many of the failures of the marketplace—information costs, restricted capital flows, lack of services, business assistance and financing to new and small businesses."

(Allen and McCluskey, 1990)

"What is new and distinct about incubators is that these features of entrepreneurship [multi-tenancy, shared office services, business counseling] occur at one location."

(Swierczek, 1992)

Swierczek defines business incubators as a strategy whose focus is understood in relation to science parks and innovation centers and as a function of emphasis on business development and research development. A business incubator's strategic focus is on business development with low involvement in research development. A science park's strategic focus is on research development with little concern for business development. An innovation center's strategic focus represents a happy medium of business and research development.

(Mian, 1994)

Mian views business incubators as mechanisms for community's to collaborate and to promote the development of technology-based firms.

(Markley and McNamara, 1995)"

"A business incubator [is] a locally based institution created to encourage and support new business development.

(Mian, 1996)

"The university technology business incubator (UTBI) is a modern enterprise development tool employed by some entrepreneurial universities to provide support for nurturing new technology-based firms."

(Greene and Butler, 1996)

"The purpose of a business incubator is to provide some combination of necessary resources in order to nurture a new and/or growing business to some level of maturity."

(Sherman, 1999; Sherman and Chappell, 1998)

"One popular vehicle to encourage new businesses in local economies is the business incubation program ... [one of] a number of federal, state, and local government-sponsored intervention programs ... introduced to facilitate the creation and growth of small start-up businesses."

(Roper, 1999)

"Business incubators provide one mechanism by which start-up businesses with high growth potential can be helped to succeed."

(Hansen *et al.*, 2000)

"Business incubators ... nurture and grow start-ups in the Internet economy. They offer fledgling companies ... office space, funding, and basic services such as recruiting, accounting, and legal—usually in exchange for equity stakes."

(Rice, 2002)

"A business incubator—in collaboration with the community in which it operates—is a producer of business assistance programs."

(NBIA Website)

National Business Incubation Association (NBIA): ''A business incubator is an economic development tool designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding.''